DOCUMENT RESUME

ED 151 313 SP 012 272

AUTHOR Wright, Emmett L.
TITLE The Effect of Film Mediated Intensive Instruction on Basic Problem Solving Skills of Ninth Graders.
PUB DATE Mar 78
NOTE 23p.; Paper presented at the Annual Meeting, American Educational Research Association (Toronto, Canada, March 27-31, 1978)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Cognitive Development; Grade 9; *Instructional Films; *Instructional Technology; Junior High Schools; *Junior High School Students; Media Research; *Observation
IDENTIFIERS *Hypothesis Formation

ABSTRACT

This study examined the effect on junior high school students of film-mediated, intensive instruction in either observing details or in generating hypotheses on basic problem solving skills; the study stemmed from teachers' indications that lack of sophistication in these areas has led to more structured activities. One hundred and twenty randomly selected ninth-grade students were shown film loops illustrating seemingly unconnected or unrelated abstract events. Intensive instruction consisted of showing the film loop to a subject as many times as required until an established criterion was attained. Five dependent variables were measured during post-viewing discussion: (1) number of observed details; (2) number of questions; (3) diversity of questions; (4) number of hypotheses; and (5) quality of hypotheses. When compared to the control group's performance, both experimental groups were superior for all dependent variables, except in the case of the number of details observed by the hypothesis generation group. Both experimental groups performed equally well on all dependent variables except for a significantly larger number of details observed by the group intensively instructed in observing details. Retesting fourteen months later produced similar results, with the group instructed in observing details exhibiting the greatest superiority over the control group. (Author/MJB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED151313

THE EFFECT OF FILM MEDIATED INTENSIVE INSTRUCTION ON BASIC PROBLEM SOLVING SKILLS OF NINTH GRADERS

EMMETT L. WRIGHT
DEPARTMENT OF SECONDARY EDUCATION
UNIVERSITY OF MARYLAND
COLLEGE PARK, MARYLAND 20742

Paper Presented at the Annual
Meeting of the American Educational
Research Association
Toronto, Canada
March, 1978

Printed in U.S.A.

SP012 272

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Emmett L. Wright

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND THE ERIC SYSTEM CONTRACTORS."

Objectives

Many of the junior high school science and social studies curriculum projects (particularly those sponsored by the NSF) present problems which require students to make accurate and detailed observations, to ask appropriate questions for the purpose of refining an understanding of the relevant variables and to develop a hypothesis which explains the relationship between variables. Teachers often complain that inadequate student sophistication in these basic problem solving skills has lead, in many instances, to more structured activities. This study examined the utilization of intensive instruction in observation (cue attendance) or hypothesis generation as a model for improving, for both the short and long term, the basic problem solving skills of ninth grade students.

Theoretical Framework

Several studies (Suchman, 1961; Gibbs, 1967; Barker, 1970; and Quinn, 1971) at the elementary and secondary level provide some support that through the use of film mediated instruction which identifies the specific criteria for judging "good" questions and hypotheses, subjects can improve their questions (both in terms of number and diversity) and their hypotheses (both in terms of number and quality). None of these studies considered individualized intensive instruction to criterion as an instructional treatment. Also, in all cases no follow-up study was conducted to examine for positive effects of instruction over an extended period of time.

In a study with college students (Salomon, 1970; Salomon and Sieber, 1970), it was determined that intensive instruction to criterion in either cue attendance and hypothesis generation lead to greater hypothesis generation, cue attendance and information search behavior than individuals not receiving intensive instruction. Significantly, the intensive instruction employed by Salomon neither provided the criteria nor taught strategies which would permit the subjects to establish a framework for improving their skills. Instead, as contrasted with the studies outlined earlier, he simply positively reinforced acceptable hypothesis or details as they were generated by the subject. In addition, he found that a delayed posttest of information search (given seven days after the immediate posttests) provided evidence that intensively instructed subjects produced a significantly greater number and diversity of questions than did the control group.

Salomon's intensive instruction procedure incorporated a randomly spliced film from which the subjects either attempted to explain the events through hypothesizing or simply list details, both to a criterion level.

Salomon generalized that forcing a student to observe many details of a discrepant phenomenon increases his subjective response uncertainty. In future situations, both the increase in ability to observe details and consequent increase in uncertainty in responding, enhances the conflict between possible explanations. This state of conflict is "relieved" by information search and by generating

additional and more acceptable (to the student) hypotheses. Salomon also concluded that instructing a student to generate many hypotheses has a similar effect upon future ability to ask questions and generate hypotheses. Thus, it seems that both instruction in cue attendance and hypothesis generation increases the future subjective response uncertainty of a subject and leads to an increased capability to solve problems for college level students. Salomon speculated that intensive instruction could prove beneficial to other student age levels if there were provided the appropriate training medium.

Berlyne (1965) provides some additional ideas which may be useful in interpreting Salomon's findings. He states that novel, complex, incongruous, or surprising stimuli evoke many possible responses and thus involve conflict and response uncertainty. Depending upon the specific nature of the variables within the stimuli, i.e., whether they are "novel," "incongruous," "complex," or "surprising," there is some form of discrepancy between the observer's expectations and the information received. According to this line of reasoning, conflict is a result of the simultaneous instigation of a number of incompatible response tendencies by the various elements of the stimulus. The result of the state of conflict is exploratory behavior, curiosity and information search. The strength of the exploratory behavior aimed at reducing conflict to a tolerable level depends on the strength of the response conflict.

Design

In assessing existing film-mediated instructed developed to encourage inquiry, Suchman's Inquiry Development Program (1966), for grades six through nine, is designed specifically to enhance skills in formulating and testing theories through the process of scientific discovery. The program focuses around short, silent eight millimeter filmloops. According to Suchman, each filmloop illustrates without captions or title, concrete discrepant events which "merely presents to the student data about a small segment of reality that has been selected to challenge his concepts and understanding." In other words the student observes abstract events, seemingly unconnected or unrelated, which illustrate phenomena the opposite of expectation.

Even though the Suchman filmloops do not display the random mixing of a story line, as found in Salomon's training medium, they do present conceptual discrepancies which are "novel", "complex", "incongruous" and "surprising". This suggests that requiring a subject to either observe in a Suchman filmloop a difficult number of details (intensive instruction in cue attendance) or to generate a difficult number of hypotheses (intensive instruction in hypothesis generation) would enhance his subjective response uncertainty. This study utilized Suchman's filmloop, "The Balloon in the Jar," for intensive instruction. The filmloop was selected because it was judged by a panel of colleagues as the most abstract and confusing presentation in the Program set of filmloops. A selected group of ninth grade students also judged the filmloop as the one least understood. Over one-half of the students indicated they could not find any meaning in the seemingly random sequence of events which displayed a bell jar, guages, and the shrinking and expansion of a balloon.

120 randomly selected ninth graders from two school districts in Pennsylvania were assigned equally to the two treatment groups and the control group. Male and female representation in each group was approximately equal.

For both Phase I and Phase II data, the three treatment groups results for each of the five dependent variables were submitted to a one-way analysis of variance. Wherever the F-value was significant the Tukey method, modified for unequal n's, in Phase II, was employed to test for significance differences between all pair-wise mean contrasts. The Tukey Technique controlled for type I error.

Each null hypothesis was rejected if the F-value equaled or exceeded the critical F-value for the .05 level of significance, or if the t-value equaled or exceeded the critical t-value represented by the .05 level of significance.

Techniques

The investigator projected the intensive instruction filmloop through once completely before permitting response from the subject. Each acceptable detail or hypothesis was reinforced with a "good," "O.K.," "very good," etc., if it (a) described a relevant detail or acceptable hypothesis and (b) had not been reported previously by the subject. The investigator did not in any case discuss the criteria which would be used to judge the relevance, diversity or quality of a response. If and when the subject could not give additional details or hypotheses, he was shown the intensive

Intensive instruction consisted of showing the Suchman film-loop to a subject as many times as required until he reached the established criterion (established in the pilot study as 75 details or 5 hypotheses).

As recommended by Campbell and Stanley (1963) a posttest only control group design was employed to test the effects of intensive instruction upon the dependent variables:

R	X_1	O_1	O_2	O_3	O_4	O_5
R	X_2	O_1	O_2	O_3	O_4	O_5
R		O_1	O_2	O_3	O_4	O_5

The treatment variables, each of which have been discussed previously are:

X_1 Intensive instruction in observing details

X_2 Intensive treatment in hypothesis generation

The dependent variables, each of which also has been discussed previously, are:

O_1 number of observed details

O_2 number of hypotheses

O_3 quality of hypotheses

O_4 number of questions

O_5 diversity of questions

instruction filmloop again. This procedure was continued until the subject reached criterion.

In phase one, immediately following intensive instruction each subject was randomly shown three additional Suchman filmloops and asked to volunteer, as the case may be, details (Filmloop, "The Five Pendulums"), questions (Filmloop, "The Spring"), or hypotheses (Filmloop, "The Sailboat and the Fan") which would help in solving the problem presented in the particular filmloop.

Phase two, conducted fourteen months later, utilized another set of Suchman filmloops to assess the long term effects of the original instruction [details (Filmloop, "The Shrinking Balloon"), questions (Filmloop, "The Spring Carts"), and hypotheses (Filmloop, "The Wrenches")] . Thus, both phases investigated identical questions: Were there differences between either experimental intensive instruction group and the control group; or differences between the two experimental groups in their capacity to observe relevant details, to ask questions or to generate acceptable hypotheses? Specifically, five dependent variables were measured: (1) number of observed details; (2) number of questions; (3) diversity of questions; (4) number of hypotheses; and (5) quality of hypotheses.

Data Sources

Each session was recorded in longhand and audiotaped to insure accurate analysis. For the number of details, hypotheses and information search questions a simple talley was made for

each student. The carefully validated hypothesis Quality Scale, developed by Quinn (1971) was employed to determine the quality of the hypotheses. All hypotheses, were rated on the Scale from zero to five and an average was calculated for each subject. Quinn found an interrater reliability of 0.94 for the Scale.

Details are defined as specific bits of data occurring in a natural phenomenon which can be classified as events, objects, conditions or properties (Suchman, 1966). Information search questions are defined as questions asked by a subject to develop a theory or hypothesis about an observed phenomenon. Questions can only ask for facts (no inferences, conclusions, etc.) so that the experimenter can answer with either a "yes" or "no". Questions are classified as either verification, experimentation, necessity or synthesis types (Suchman, 1966).

Each category of information search questions can be asked about each specific type of detail creating a total of sixteen types of questions. The diversity of questions, or the relative information search uncertainty was calculated following the procedures outlined by Attneave (1959).

To insure accurate classification a randomly selected hypothesis and questions from study responses were analyzed by the investigator and two junior high school teachers. Kendall's coefficient of concordance produced coefficient values of 0.83 for the hypotheses and 0.94 for the questions.

Results

Analysis of variance (Table I) indicated that for both immediately after instruction (Phase I) and in the long-term (Phase II), students in the three treatment groups differed significantly in: the number of details (Phase I, $F = 68.69$, $p < .001$; Phase II, $F = 7.35$, $p < .01$); the number of acceptable hypotheses (Phase I, $F = 8.87$, $p < .001$; Phase II, $F = 3.67$, $p < .05$); the quality of hypotheses (Phase I, $F = 31.32$, $p < .001$; Phase II, $F = 19.87$, $p < .001$); the number of questions (Phase I, $F = 7.23$, $p < .01$; Phase II, $F = 10.11$, $p < .001$); and the diversity of questions (Phase I, $F = 22.00$, $p < .001$; Phase II, $F = 12.00$, $p < .001$).

For Phase I, the follow-up general t-statistic (Table II) provided evidence that subjects intensively instructed in observing details produced more details than the hypotheses generation group ($t = 9.25$, $df = 117$, $p < .001$) or the control group ($t = 10.28$, $p < .001$). No significant difference existed between the hypotheses generation group and the control group.

Both intensive instruction groups offered more hypotheses of a higher quality than the control group [number - ($t = 2.85$, $p < .05$), ($t = 4.02$, $p < .001$); quality - ($t = 5.27$, $p < .001$), ($t = 7.49$, $p < .001$)]. In either case no significant differences were observed between the two intensive instruction groups.

An identical pattern of findings was determined for the number and diversity of questions. No differences were found between the two intensive instruction groups, but both were superior to the control group [number - ($t = 3.09$, $p < .05$), ($t = 3.02$, $p < .01$);

diversity - ($t = 4.89$, $p < .001$), ($t = 5.52$, $p < .001$)].

It can be concluded that both intensive instruction techniques were equally effective in improving the short-term basic problem solving skills of subjects with the exception of the number of observed details, in which case subjects intensive instructed in observing details exhibited superior performance.

For Phase II, the follow-up general t-statistic, utilizing the Tukey method modified for unequal n's, produced results similar to the Phase I analysis. Subjects intensively trained in observing details named more details than either the hypotheses generation group ($t = 6.88$, $df = 51$, $p < .01$) or the control group ($t = 8.30$, $p < .01$). Again no difference was observed between the hypotheses generation group and the control group.

Subjects in both intensive instruction groups generated more acceptable hypotheses than the control group ($t = 6.88$, $p < .01$; $t = 8.30$, $p < .01$). No significant difference was found to exist between the intensive instruction groups. In terms of quality of hypotheses the hypotheses generation group produced higher quality hypotheses than the control group ($t = 3.54$, $p < .05$), with no significant difference found between the two intensive instruction groups or the control group and the group intensively instructed in observing details.

Both intensive instruction groups asked a greater diversity of questions than did the control group ($t = 3.62$, $p < .05$; $t = 6.60$, $p < .01$). No difference was found to exist between the two intensive instruction groups.

It can be concluded that in terms of overall long-term effectiveness, the subjects intensively instructed in observing details performed significantly better than the other two groups on three dependent variables: quantity of cue attendance; quantity of information search and diversity of information search; and significantly greater than the control group for the number of hypotheses. Only for the quality of hypotheses did the hypotheses generation intensive instruction group perform better than the cue attendance subjects.

Significance

The conclusions suggest that intensive instruction in either cue attendance or hypotheses generation will provide selective long term effects upon the subject's subjective response uncertainty. When compared to the data gathered immediately after intensive instruction it can be noted that those subjects intensively instructed in cue attendance can still perform fifteen months later at significantly better levels than the control group on all dependent variables except for the quality of hypotheses and even on this variable the Tukey Method pair-wise analysis indicated a t-value close to significance ($t = 3.11$, $p < .10$).

The present study lends support to Salomon's conclusion that intensive instruction with an event which creates a discrepancy between the observers' expectations and the information received evokes conflict and response uncertainty. In other words, forcing the subject to attend to a large number of details in the event, either directly through recall, or indirectly through the identifi-

cation of variables in hypothesis formation, heightens the conflict and results in the simultaneous instigation of a number of incompatible response tendencies. This in turn leads to enhanced exploratory behavior, curiosity and information search when exposed to future conceptual discrepancies.

In the practical sense, because functional problem solving skills are utilized by students on a continual basis in junior high school science and social studies courses, it would seem that instruction in cue attendance, and possibly in hypothesis generation, could profitably become an appropriate activity for junior high school students; especially in light of their long term benefits.

As an additional note the system of posttests developed for this study could provide for researchers a simple and reliable format for the evaluation of classroom activities or teaching strategies designed to improve the basic problem solving skills of individual students.

Recommendations for Future Study

This study was limited in its scope by factors of time, reduced sample size, experimental design and the intensive instruction strategies. The following recommendations focus on areas for future research:

1. The present study dealt with only ninth grade Ss. It is recommended that the experimental procedures be extended to other junior high school grades.
2. The criteria for intensive instruction were determined from a pilot study. During the experimental study, the

intensive instruction tasks were found to be difficult, but not impossible, by the students. It is recommended that the criteria be raised to a higher level (i.e., 100 details and 7 hypotheses) to see if this has any effect upon immediate and long term performance.

3. Each student was exposed to one intensive instruction session. It is recommended that an experiment be performed where the intensive instruction is repeated at least once prior to the posttests.
4. The study presents a model for investigating means of improving basic inquiry skills. It is recommended that future research should examine for possible ways of improving the ability of students in the higher cognitive levels of inquiry; e.g., devising tests for hypotheses (controlled experiments), drawing conclusions and evaluating conclusions.
5. The investigator noted that during the posttests the number of times students requested to see the filmloops and the amount of time needed to complete the tasks varied from student to student. It is recommended that an investigation be performed to determine if the method of intensive instruction influences the amount of time and the number of requests.
6. It is assumed that improved ability in the open-exploration skills (as determined in a clinical setting) will carry over to classroom interactions. This may not be a valid assump-

tion. Future experimentation should evaluate the effects of intensive instruction upon regular classroom inquiry behavior.

TABLE I

One-way Analysis of Variance of Effects of Intensive Instruction Upon Immediate and Long Term Basic Problem Solving Performance.

			Number of Details		Hypotheses				Questions			
					Number		Quality		Number		Quality	
	Source	df	MS	F	MS	F	MS	F	MS	F	MS	F
Phase I	Between Groups	2	6670.90	68.69[c]	23.06	8.87[c]	16.60	31.32[c]	174.16	7.23[b]	0.44	22.0[c]
	Within Groups	117	7.12		2.60		0.53		24.10		0.02	
Phase II	Between Groups	2	116812.12	7.53[b]	7.67	3.67[a]	7.91	19.87[c]	182.77	10.11[c]	0.24	12.00[c]
	Within Groups	51	15894.9		2.09		.90		18.07		0.02	

[a] $p < .05$

[b] $p < .01$

[c] $p < .001$

TABLE II

Results of all Pair-wise contrasts of the Three Treatment Groups Means for Each Dependent Variable as Analyzed by the General t-Statistic (Phase I Data)

Dependent Variable	Treatment Group	Mean	Rank	Mean Contrast T	Mean Contrast T	Difference	t*
Number of Details	C**	16.52	1	A	A	23.46	10.28[c]
	B***	18.88	2	A	B	21.10	9.25[c]
	A****	39.98	3	B	C	2.30	1.03
Number of Hypotheses	C	2.68	1	B	C	1.47	4.02[c]
	A	3.72	2	B	A	0.43	1.12
	B	4.15	3	A	C	1.04	2.85[a]
Quality of Hypotheses	C	1.61	1	B	C	1.25	7.49[c]
	A	2.49	2	B	A	0.37	2.22
	B	2.86	3	A	C	0.88	5.27[c]
Number of Questions	C	6.05	1	B	C	3.67	3.20[b]
	A	9.60	2	B	A	0.12	0.11
	B	9.72	3	A	C	3.55	3.09[b]
Diversity of Questions	C	0.35	1	B	B	0.19	5.52[c]
	A	0.52	2	B	A	0.02	0.63
	B	0.54	3	A	C	0.17	4.89[c]

*df=117
**Control Group
***Intensive Instruction in Hypothesis Generation
****Intensive Instruction in Cue Attendance

[a] $p < .05$
[b] $p < .01$
[c] $p < .001$

TABLE III

Results of All Pair-wise Contrasts of the Three Treatment Groups Means for Each Dependent Variable as Analyzed by the General t-Statistic (Phase II Data)

Dependent Variable	Treatment Group	Mean	Rank	Mean Contrast T	Mean Contrast T	Difference	t*
Number of Details	A**	40.90	1	A	B	17.84	6.88[b]
	B***	23.06	2	A	C	21.84	8.30[b]
	C****	19.06	3	B	C	4.00	1.50
Number of Hypotheses	A	2.97	1	A	B	.06	0.44
	B	2.91	2	B	C	1.13	7.98[b]
	C	1.78	3	A	C	1.19	7.43[b]
Quality of Hypotheses	A	3.50	1	A	B	.13	0.39
	B	3.37	2	B	C	1.08	3.11[a]
	C	2.29	3	A	C	1.64	3.54
Number of Questions	B	11.51	1	B	A	4.47	4.52[b]
	A	7.06	2	B	C	6.11	6.02[b]
	C	5.41	3	A	C	1.64	1.64
Diversity of Questions	B	.55	1	B	A	.13	3.62[a]
	A	.42	2	B	C	.24	6.60[b]
	C	.31	3	A	C	.11	3.18

*n=51

[a] $p < .05$
[b] $p < .01$

BIBLIOGRAPHY

1. Attneave, Fred. Application of Information Theory to Psychology. New York: Holt, Rinehart and Winston, Inc., 1959.

2. Barker, Robert H. "Development and Evaluation of a Method of Structuring Inquiry Films to Elicit Hypotheses from High School Chemistry Students," Paper presented at the 43rd annual meeting of the National Association for Research in Science Teaching, Minneapolis, 1970.

3. Berlyne, Daniel. Structure and Direction in Thinking. New York: Wiley, 1965.

4. Campbell, D. T. and J. D. Stanley. Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally, 1973.

5. Gibbs, Ronald K. "An Analysis of the Effectiveness of Biological Science Curriculum Study Single Topic Films in Teaching Hypothesis Construction to High School Biology Students," unpublished Doctoral Dissertation, Indiana University, 1967.

6. Quinn, Mary Ellen. "Hypothesis Formation can be Taught," The Science Teacher. Pp. 30-31, September, 1971.

7. Salomon, Gavriel. "Cue Attendance and Hypothesis Generation as Two Procedures for Producing Uncertainty in Teachers," U.S. Office of Education Technical Report 14: Stanford University. ED 045 622, 1970.

8. Salomon, Gavriel and Joan E. Seiber. "Relevant Subjective Response Uncertainty as a Function of Stimulus-Task Interaction," American Educational Research Journal. Pp. 337-349, May 1970.

9. Suchman, J. Richard. "Inquiry Training: Building Skills for Autonomous Discovery," Merrill-Palmer Quarterly. Vol. 7, pp. 147-69, 1961.

10. Suchman, J. Richard. Developing Inquiry: Inquiry Development Program in Physical Science. Chicago: Science Research Associates, Inc., pp. 51-61, 1966.